Small-scale Forest Economics, Management and Policy, 4(3): 293-310, 2005

Role of Social Aspects in Extent of On-farm Tree Growing in Subsistence Agroforestry Systems of Western Himalaya

Kamal Kishor Sood
Faculty of Forestry
North Eastern Regional Institute of Science and Technology
Nirjuli, Arunachal Pradesh, Pin 791 109, India

Many so-called society-oriented agroforestry programs, mainly in developing countries, fail because they do not take account of the social structure in their design. This study provides empirical evidence of the impact of social structure on the extent of on-farm tree growing. The study has been carried out in Mandi district of Himachal Pradesh, in Indian Western Himalaya. Analysis of survey data reveals significant relationships between extent of on-farm tree growing and caste, education of the head of household, family literacy, primary occupation, government employment, mobility of the household head, importance of tree growing for future generations, and holy tree worship practices. Households with concrete houses had more trees than households with mixed, mud and wooden houses. The study implies a need to consider social factors to encourage the level of on-farm tree growing and to design socially acceptable agroforestry programs. The study also emphasises the need for a holistic approach to agroforestry development by integrating other continuing rural development programs with that of agroforestry to increase the level of on-farm tree growing.

Keywords: caste, innovation, worship, tenure, risk, social forestry

INTRODUCTION

Like any other innovation or technology adoption, adoption of on-farm tree growing in the form of agroforestry is a complicated process that is influenced not only by physical factors but also by a number of social factors (Mercer and Hyde 1991, Chundamannil *et al*. 1993, Gilmour and Nurse 1995, Garforth *et al*. 1999, Sharma *et al*. 1999, Malla 2000, Neupane *et al*. 2002). In most developing countries the rural communities, especially those practising settled agriculture, are characterised by high social inequalities and the problem of participation in any production activity can be traced to the absence of convergent interests located in the social structure of the community (Agarwal 1986). For example, the age of the farmer has shown a varied association with innovation adoptions (Rogers 1995). While the relationship between the age of the farmer and innovation has been widely studied in agricultural situations, it has received little attention with regard to agroforestry. Lionberger (1960) and Rogers and Svenning (1969) commented that younger farmers accept change and adopt innovations more readily compared to older farmers. The work of Seikh *et al.* (2003) on zero tillage technology also suggests that social factors affect

the adoption of technology. Farmers with lower education levels are considered to be low adopters and risk averse. Rogers and Svenning (1969) and MacDonald (1976) asserted that the education level decreases from innovators to late adopters, and persons with a higher level of education are supposedly more capable of understanding the innovation. Singhal and Kumar (1997) reported a significant association between family size and tree planting in Garhwal Himalayas. Cernea (1994) and Sood (2003) emphasised the need for sociological knowledge in designing and implementing socially acceptable programs or projects. The social considerations of the farmers also determine adoptability and acceptability of agroforestry practices (Wiersum 1984, Raintree 1986).

According to Fortmann (1988), many projects that are called 'social forestry' (including agroforestry) are a far cry from the theoretical vision of being social. Many of the so-called social forestry programs fail because they do not take into account social factors (Cernea 1992). Notwithstanding this, many social forestry program administrators also do not realise that the consideration of social factors has to be woven into the very fabric of such programs from the outset (Akbar *et al*. 2000). Agroforestry as a science is in its infancy, and Ayling (1991) argued that agriculture and forestry have the same clientele, the farmers, so forestry has to take lessons from agriculture where study of social structure has already proved helpful in designing socially desirable agricultural technologies and their implementation.

Farm level studies provide insights into various factors affecting farmers' use and management of trees on farms (Scherr 1995). Most previous studies on innovation or technological adoption have concentrated on the adoption of new agricultural practices and technologies. Comprehensive empirical studies on social aspects of incorporation of trees on farms in the traditional agroforestry are non-existent. Moreover, most studies related to innovation adoption in agroforestry are concerned with *ex post* evaluations where externally or government-funded social forestry or farm forestry programs were implemented ignoring both the pre-project and traditional agroforestry practices. Various studies (Singh and Sikka 1993, Saxena 1995, Saxena and Srivastva 1995, Jha 1996, Mahapatra 1997) are examples of such post-program studies on adoption of tree planting. There is a tendency to emphasise biophysical aspects and design of agroforestry technologies without reference to social factors (Raintree 1986, Nair 1998). Investigation of social aspects of agroforestry remains a field in its infancy; a review by Mercer and Miller (1998) of papers on agroforestry published in the journal *Agroforestry Systems* over 1982-1996 revealed little attention to social aspects of agroforestry.

Like any other innovation adoption, agroforestry uptake is associated with risks, for example suppressed production of associated crops, trees providing a habitat for pests or diseases of crops, failure to achieve expected levels of production, possible theft of tree products and conflicts with neighbours over trees (Scherr 1995). Most agroforestry practices are site-specific (Nair and Dagar 1991), and information on them is mostly anecdotal (Kachru 1997). Due to the variation in circumstances within locality, environment and traditional production practices, studies on social variables need to be conducted on a case-by-case basis. The results obtained can be useful in designing agroforestry programs and policies (Hoskins 1987). If the goal is to convince people to grow trees, then the study of social aspects becomes important to identify the motivation and de-motivation to grow trees (Arnold and Dewees 1995, Walters 1997). Further, most previous studies on agricultural innovation or

technological adoption have been criticised for studying the incidence of adoption and not the extent of adoption (Feder *et al*. 1985). This paper, therefore, examines the role of social aspects of farm households in deciding the extent of on-farm tree growing.

THE STUDY AREA

A survey was carried out in Mandi district, one of 12 administrative districts of the Indian state of Himachal Pradesh in the Western Himalaya (Figure 1). This district is situated at 31^o 13’-32^o 04’ north latitude and 76^o 37’-77^o 23’ east longitude (Balokhra 1999). The mean monthly temperature ranges between 20^oC and 32.5^oC, and the mean precipitation is 156.8 cm (Balokhra, 1999). The total area of the Mandi district is 3950 km^2, with a tree cover of 1539 km^2 (FSI 1999). Almost all the forests in the district are state-owned, and local farmers have recorded rights to collect timber, fuel, fodder and forest products from these forests for their domestic needs. A majority (84.5%) of the total landholdings in the state are small (<2 ha) (GOHP 2001). Land use in Himachal Himalaya is basically an agroecosystem where 90% of the population inhabit villages the economies of which are dependent on agriculture, horticulture, silviculture and animal husbandry (Atul *et al*. 1994). The common feature of the farming systems in this area is a deliberate retention of naturally growing trees or planting in agricultural fields and along field boundaries, in home gardens, intercropping in orchards (fruit tree cultivation) and along the boundary of these orchards, and privately owned grasslands. Agrisilvicultural, agrisilvihorticultural, sivipastoral, agrohortisilvicultural, hortiagricultural and hortisilvicultural are the main forms of traditional agroforestry systems in the area (Verma and Mishra 2000). *Grewia optiva*, *Populus deltoides*, *Salix* spp., *Albizzia* spp., *Celtis australis*, Bamboo, *Bauhinia variegata*, *Ulmus villosa*, *Toona ciliata*, *Prunus cersoides*, *Quercus leucotrichophora*, *Cedrus deodara* and *Pyrus pashia* are common multipurpose forest tree species which occur on the farms.

Joint Forest Management (JFM) commenced in 1993 in Himachal Pradesh, for protection, afforestation, pasture development and soil conservation in degraded forests (including community lands), to arrest environmental degradation and to augment fuelwood, fodder and small timber production of local people through their participation in planning, protection, afforestation and eco-development of degraded forests.

There are 4.95 M Hindus, Muslims constitute 0.09 M, Sikhs 0.05 M and others including Christians, Buddhists and Jains constitute 0.08 M (GOHP 2000). Caste is an important criterion for social stratification which defines the social structure in Himachal Pradesh which consequently affects the nature and distribution of economic activities (Negi 1993). Brahmins form the topmost strata in caste hierarchy, while Rajputs, Khatris, Suds and Mahajans form the middle castes. The scheduled castes (SCs) form the lower castes and constitute 25.3% of the state’s population (GOHP 1997). SCs are culturally marginalised from the mainstream and have suffered severe economic deprivation and social discrimination (Verma and Partap 1992). This group comprises a number of subcastes. The lowest group amongst SCs are Chamars, who are usually leather workers, shoe-makers and scavengers. Scheduled tribes (STs) form another socially and politically under-

privileged group and constitute 4.2% of the state's population (GOHP 1997). Most of the schedule tribes contain all common Hindu castes.

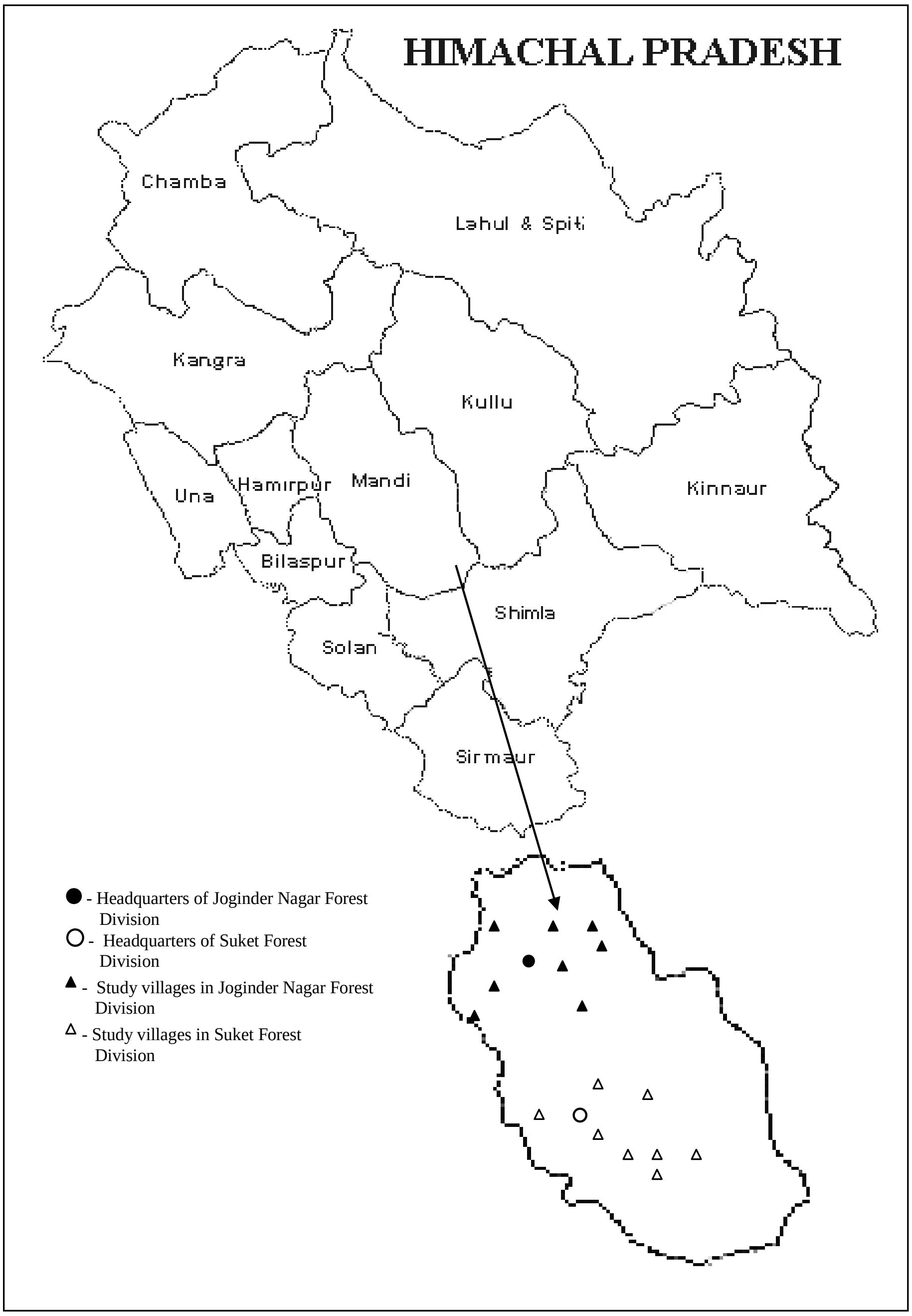

Figure 1. Location of study villages

The economy of the state is mainly dependent on agriculture and its allied activities. Agriculture is a means of livelihood for the vast majority of the state's population and is a major source of employment (Sood and Sood 2000). There is limited scope for mechanised farming due to the preponderance of smallholdings and terraced fields (GOHP 2001). The scope for industrialisation is limited due to topography (hills) and infrastructure constraints. Due to the low level of industrialisation, trade and commerce compared to adjacent states of Punjab and Haryana, jobs in government departments form the second most important source of employment.

DATA COLLECTION AND ANALYSIS

Surveys have been widely used in India in the past to collect information on forest resource use, joint forest management, social forestry adoption and psychological aspects of forest users (Mahapatra 1997, Sood *et al.* 2000, Glendinning *et al.* 2001, Sood 2004). Since the household is the decision-making unit regarding growing trees (retaining natural trees and planting trees) on its own farm, primary data were collected by surveying the heads of households in the study area. Because 25% of the population of this district is illiterate, the data were collected using a structured questionnaire through face-to-face interviews with the heads of households.

Questionnaire Preparation

After a review of the literature and discussions with project supervisors, a questionnaire was drafted. This contained questions on social aspects of the farm households and number of trees on the farms, as well as on demographic profile, economic aspects and forest resource use of the householders. Mock interviews were conducted with colleagues to check how long interviews would take and how the questions would be interpreted by respondents. The questionnaire was also discussed with a few farmers in the study area and with experts in forestry and agriculture both in the State Forest Department and at the University of Horticulture and Forestry, Himachal Pradesh (India).

A pilot survey was carried out in the village of Chaugan in the Mandi district, using a random sample of 25 households, after which the questionnaire was revised. Discussions were held with groups of key informants in each selected village before carrying out the household survey to gain a broader idea about socio-economic conditions and forest resource use of the villagers. This also helped in establishing good rapport with the villagers.

Sampling Procedure

Multistage sampling was used to select households. The Mandi district is divided into five forest divisions for forest administration. It was therefore considered appropriate to take these forest divisions as sampling units in the first stage. As hills impose a set of constraints and opportunities that differ from foothills, Joginder Nagar and Suket Forest Divisions, which both contain hills and foothills, were selected.

Lists of villages where a joint forest management program is operational, and non-JFM villages, for each of hill and foothill categories were prepared with the help of divisional forestry staff of each selected forest division. Two villages from

each sub-category for hill and foothill villages were chosen in each selected forest division using simple random sampling. In this way, there were eight sample villages in each selected forest division and 16 villages in total (Figure 1).

Since data were not available on the number of households in each village, a list of households in each of the selected villages was prepared by employing data collectors. The farm size of each household was also recorded during this stage. The farmers in each selected village were divided in two categories: small (<1 ha) and large (≥ 1 ha). A sampling fraction of one in three households was adopted for large and small farmers for each selected village, the total sample size being 401 households.

The data were collected from August 2001 to May 2002. Each village was visited before administering the questionnaires. Farmers were notified of the intentions and timing of fieldwork. During the survey, the author and other interviewers stayed in the study villages. Interviews were conducted during the evenings (near dinner time) and early mornings, for farmers who were available only during theses times. A response rate of 95% was obtained.

Data Compilation and Statistical Analysis

Data compilation involved the coding of data and entry on computer through SPSS (Statistical Package for Social Scientists) Version 11.0 for MS Windows. Because data for extent of tree growing (number of trees per household) did not follow a normal distribution, to test difference between numbers of trees per household across categories of independent variables, the non-parametric Mann-Whitney U[1] test was utilised where there were two categories of independent variables and Kruskal-Wallis[2] test was applied for independent variables with more than two categories. The median numbers of trees was taken as a measure of central tendency. The chi-square test of independence was used to examine the association between pairs of categorical variables. Spearman's rank correlation was used to test the relationship between pairs of independent variables where at least the variables were ordinal. A critical significance level of 5% was adopted for association between independent variables and extent of tree growing. The central hypotheses for the household study were:

$H_{0:}$ There is no association between household social factors and extent of tree growing.

$H_{1:}$ There is association between household social factors and extent of tree growing.

The extent of tree growing[3] is measured as number of trees on the farm. Family literacy, mobility index and food self-sufficiency of households were estimated using Sood's (2003) formula. Adult Male Equivalents (AME) for family labour were estimated using the Jacob and Alles (1989) method.

---

[1] The Mann-Whitney statistic has been denoted by Z.
[2] The Kruskal-Wallis statistic has been denoted by KW.
[3] On-farm tree growing includes all types and species of trees on the farm.

SURVEY FINDINGS AND DISCUSSION

Age of Household Head

No significant relationship was detected between the age of the household head and extent of on-farm tree growing, although the median number of trees increased with increasing age class (Table 1). There was a positive and significant correlation between age and farm size ($r_s = 0.205$, $p<0.0001$). Therefore, an increase in the number of trees per farm with an increase in age class could be attributed to the increase in farm size with age.

Table 1. Number of trees per household as influenced by age of head of household

Age class (years)	Number of households	Mean rank	Median number of trees
Young (21 to 39)	78	193.2	25
Old (40-60)	193	193.9	28
Very old (61 and above)	130	216.3	47

KW = 3.338, df = 2, $p<0.188$.

Caste Structure

Caste means four scripturally sanctioned status groups of Hinduism, namely Brahmins (priests), Kshatriyas (rulers or warriors), Vaishyas (traders or herdsmen) and Shudras (servants). Caste is a social group held together by internal and external forces. Lower castes lag behind in terms of human development and continue to be the victims of systematic discrimination in India (DFID 1999). The households were broadly divided into upper (all castes except SCs and STs) and lower castes (SCs and STs). The mean rank for total number of trees was significantly higher in upper caste than for lower caste households (Table 2).

Table 2. Number of trees per household as influenced by caste

Caste	Number of households	Mean rank	Median number of trees
Lower caste	139	155.9	13
Upper caste	262	224.9	46

Z = 5.679, df = 1, $p<0.0001$.

The fewer trees per household in the lower caste households appear to be related to food security, a critical livelihood objective for survival, particularly where agriculture is mainly subsistence. A positive correlation was found between food self-sufficiency and caste ($r_s = 0.146$, $p<0.003$); lower caste households were less food self-sufficient than higher caste households. This could be further attributed to resource differentials, particularly farm size. Less food self-sufficient households would be more likely to place greater emphasis on food production as their livelihood strategy and hence tree growing would be a secondary consideration.

Farm size also varied significantly with caste (r_s = 0.385, p<0.0001). Further, there was a significant positive correlation between farm size and food self-sufficiency (r_s = 0.457, p<0.0001). Because the lower caste had lower food self-sufficiency coupled with lower farm size, tree growing in the lower caste might have been constrained by farm size and the greater risk to an existing lower food sufficiency than for upper caste households.

One of the options to reduce this risk is to limit the extent of on-farm tree growing. Wealth status is one of the factors that cushion the risk of adoption of any innovation, and total household annual income is one of the indicators of wealth status of farmers. Total household annual income was found to be significantly correlated with caste (r_s = 0.279, p<0.0001). This implies that lower caste households had a lower income than upper caste, and a lower capacity to bear the risk of adoption of an innovation and are likely to grow fewer trees.

Culturally, upper caste people avoid manual work in the study area, and therefore tree growing (which requires lower labour intensity than agriculture) is attractive. In the study area most agricultural holdings are not large enough to use hired labour economically and to attract agricultural workers from other regions. The availability of labour for farming has also decreased due to the breakdown of the patron-client relationship between landlord and tenant over time due to land tenancy reforms in the state. Due to land reform, most households in this region now own agricultural land and thus during peak agricultural activities (mainly sowing and harvesting) most of the farmers are busy cultivating their own land. Most of the people prefer not to work as agricultural labourers because the work is seasonal, uncertain and with harsh conditions (such as muddy fields in the rainy season during kharif crop cultivation) compared to off-farm work (government jobs, off-farm labour work, taxi drivers, mechanics, electric wiremen, shop assistants) now available.

Even within the lower caste, the number of trees per household increased with increase in land holding size (KW = 75.796, p<0.0001). The median number of trees of low caste farmers were 8, 10, 43, 46 and 184 respectively for marginal (≤0.125 ha), small (0.125-0.250 ha), semi-medium (0.251-0.500 ha), medium (0.501-1.00 ha) and large (≥1.00 ha) holdings. Similarly, the median number of trees increased with increase in food sufficiency within the lower caste (KW = 51.568, p<0.0001); the median number of trees was 0, 5, 14 and 47 for nil, 1.0-50%, 50.1-100.0% and ≥100.1% food sufficiency classes respectively within the lower caste. The number of trees for lower caste households also increased significantly with an increase in total annual household income (KW = 47.710, p<0.0001). The median number of trees within the lower caste was 5, 13, 43 and 91 respectively for ≤18000 Rs., 18000-54000 Rs., 54001-110000 Rs. and ≥110001 Rs. income categories.

Type of Dwelling

There are four main types of houses in the study area – concrete, mixed (mud and concrete), mud and wood – in decreasing order of social status of the household. Households with concrete houses had the highest median number of trees (113) followed by mixed houses (69) (Table 3). The lowest median number of trees was in households with wooden houses (12 trees), although this was similar to households with mud houses (14 trees).

Table 3. Number of trees per household as influenced by type of house owned

Type of dwelling	Number of households	Mean rank	Median number of trees
Mud	94	156.7	14
Mixed (mud and concrete)	72	249.1	69
Wood	128	144.7	12
Concrete (cement)	107	274.9	113

KW = 100.143, d = 3, $p<0.0001$.

The variation in the median number of trees with the type of the house owned could be attributed to strong association of house type with economic status (total annual household income) (KW = 132.132, $p<0.0001$). Households with concrete houses had the highest median annual income (119200 Rs.), followed by households with mixed houses (78,400 Rs.), households with mud houses (33,600 Rs.), and finally households with wooden houses (28,800 Rs.). Households with concrete houses with their higher income could bear a greater risk of growing trees than households with mixed, mud or wooden houses and therefore they would more likely to adopt on-farm tree growing to greater extent.

Family Type

A family was considered *joint* where more than two married brothers with their parents and relatives live together. Families with an adult person, spouse and unmarried children or brothers or sisters and aged parents were regarded as *nuclear* families. Culturally, the unmarried brothers and sisters are treated by the elder brother like his own children. Intuitively, it may be more difficult in joint families than in nuclear families for the head of household to take a decision to adopt a technology or to grow trees due to the greater influence of other sub-units (sub-families). Alternatively, other members of the joint family may help or motivate the head of household towards extending farm level tree growing. No significant difference in the number of trees between farms of joint and nuclear families was observed (Table 4).

Table 4. Number of trees per household as influenced by family type

Family type	Number of households	Mean rank	Median number of trees
Nuclear family	247	208.3	38
Joint family	154	189.2	31

Z = .606, df = 1, $p<0.108$.

Family Size

There could be two broad arguments about the effect of household size on tree growing. A larger family may mean greater availability of labour which can be utilised for growing woody perennials on farms. Households with large families will place a greater demand on resources, hence they will be motivated to increase output

through innovation adoption. Larger families would require more woody perennials for fuelwood, fodder, timber and fruit for household utilisation and to generate extra income to sustain their livelihoods. Hence, the size of the family can be expected to have a positive association with tree growing. A counter view would be that households with large families have more people to feed from a given unit of land, and therefore may replace trees with food crops. The difference in total number of trees owned by different sized families was non-significant (Table 5).

Table 5. Number of trees per household as influenced by family size

Family size	Number of households	Mean rank	Median number of trees
Small (1-3)	106	205.7	36
Medium (4-7)	249	192.6	31
Large (≥ 8)	46	236.0	57

KW = 5.693, df = 2, p<0.058.

Education Level of Head of Household

There was a highly significant consistent increase in the number of trees with an increase in education level of the household (Table 6). Cultural traditions in the study area reveal that educated persons consider manual jobs beneath their dignity and therefore shun agricultural operations and might grow trees which are less labour intensive. The education level of the head was highly significantly correlated with household total income ($r_s = 0.469$, $p < 0.0001$). This could be due to relatively better access to off-farm income, particularly for government employment. As highly educated farmers had a higher total annual income, they were better able to bear the risk of increasing the level of adoption of any innovation, including tree growing. Consequently, households with a higher education level tended to have more on-farm trees.

Table 6. Number of trees per household as influenced by education level of head of household

Education level of head	Number of households	Mean rank	Median number of trees
Illiterate (0)	168	153.2	13
Primary (Level 1-5)	80	200.9	30
Matric (Level 6-10)	117	241.8	58
College (Level 11 and above)	36	291.7	200

KW = 65.259, D.F. = 3, p<0.0001.

Family Literacy

Family literacy plays an important role in farm decision-making and may influence adoption of new technology. Culturally, in the present study farming decisions are undertaken by the head of household. However, education of the other members of household may change his vision and influence his decision on adoption of new

ideas or practices. For instance, plantation work done in schools by children may influence the head of household to grow trees.

The number of trees was positively and significantly related to family literacy (Table 7). This is consistent with field experience and discussion with key informants, that educated persons consider cultivating agricultural crops against their dignity. A highly significant and negative association between family literacy and family labour available for agriculture was also found (r_s = -0.273, p<0.0001). Therefore, comparatively more educated families might have grown (retained or planted) trees on their land, which is usually less labour intensive than agriculture.

Table 7. Number of trees per farm household as influenced by family literacy

Family literacy index	Number of households	Mean rank	Median number of trees
Very low literacy (0.00-0.50)	85	124.66	11
Low literacy (0.51-1.50)	173	197.62	35
Medium literacy (1.51-2.50)	100	238.15	60
High literacy (2.51-6.00)	43	279.14	125

KW = 66.993, df .= 3, p<0.0001.

Primary Occupation of Head of Household

The extent of resources (land, labour and capital) available for farming depends on the occupation of the farmer. For instance, households with a non-agricultural occupation would have less time or less labour available for agricultural activities. For the present study, the occupations were broadly classified as agricultural (where the head of household considered the growing of agricultural crops as his main occupation) and non-agricultural.

There was a significantly greater level of tree planting among non-agricultural households (Table 8). The correlation between occupation (agricultural and non-agricultural occupations, assigned values 1 and 2 respectively) and availability of labour for farming (r_s = -0.123, p<0.012), indicating that the availability of labour for agriculture decreased from agricultural to non-agricultural occupations. Therefore, household heads with a non-agricultural occupation might be expected to grow more trees than those where agriculture is the major occupation. Another reason could be the higher total income of non-agricultural households, which improves the risk-bearing capacity of the household to grow trees. There was a highly significant positive correlation between occupation and total household income (r_s = 0.352, p<0.0001), which supports this view. Moreover, there was a highly significant positive correlation between occupation and education level of the farmers (r_s = 0.352, p<0.0001). Farmers with a higher education level followed non-agricultural occupations owing to more opportunities and cultural affinity for white collar work and consequently tended to grow more trees than agriculturists. This finding agrees with Royer (1987) who reported that reforestation was significantly and negatively influenced by agriculture being the primary occupation.

Table 8. Variation in number of trees per household with primary occupation

Occupation	Number of households	Mean rank	Median number of trees
Agricultural	212	176.4	23
Non-agricultural	189	228.6	50

Z = 4.511, p<0.0001.

Government Employment

Off-farm employment affects farming decisions because it affects resources available for farming (time, energy, labour and capital). Moreover, government employment provides a secure source of income for the family. Government service is one of the major sources of off-farm employment in the study area.

The number of trees per farm was significantly lower in households without any government employee to those having government employees (Table 9). The greater number of trees in households with government employees could be due to the capacity of the household to take risks of adoption of tree growing because government employment in the study area is an assured source of income. Total annual income of the household was highly correlated with government employment (r_s = 0.481, p<0.0001). Households with government employment have a higher risk-bearing capacity and are thus likely to grow more trees. Moreover, households with government employment will have less time for labour-intensive agriculture as evident from the negative correlation between government employment and number of persons (adult male equivalents/ha) of agricultural holding available for agriculture (r_s = -0.190, p<0.0001). Households with government employment are likely to adopt less labour-intensive use of land and tree growing suits such a requirement.

Table 9. Number of trees per household as influenced by government employment

Government employment	Number of households	Mean rank	Median number of trees
No	287	184.5	27
Yes	114	242.7	61

Z = 4.540, df = 1, p<0.0001.

There was a highly significant association of government employment with education level of the family (r_s = 0.354, p<0.0001), because education gives better access to government jobs.

Land Tenure

Since sharecropped land might be transferred to sharecroppers due to land reforms in the study area, the landlords might grow more trees to maintain the ownership of their land. On the other hand as sharecroppers are usually paid a fixed proportion of the agricultural produce, they will be more interested in agricultural production than tree growing. Hence sharecropped farms would more likely have fewer trees than

self-cropped farms. No significant difference was detected between the number of trees grown on self-cropped and sharecropped farms (Table 10).

Table 10. Number of trees per household as influenced by land tenure

Land tenure	Number of households	Mean rank	Median number of trees
Share cropping	37	219.3	35
Self cropping	364	199.1	29

Z = 1.011, df1, $p<0.312$.

Mobility of the Household Head

Laggards have fewer contacts with the outside world (Rogers 1995). Mobility exposes farmers to the outside world, new innovations and new ideas by increasing their contact with other people or just through observing the new practices or techniques, particularly farming practices outside their own homes. Consequently, mobile farmers are likely to have a greater awareness of different farming practices, and farmers' mobility may influence farm-level decision-making. In the current study, a mobility index was estimated using the frequency of visits to tehsil, district headquarters and places outside the district, and farmers were categorised as in Table 11. The total number of trees per household increased significantly with increase in mobility of the head of the household (Table 11). This finding agrees with that of MacDonald (1976), who stated that adoption of innovation depends on contact with the outside world and noted the significant impact of the farmers' outside travel on the level of involvement in agricultural activities by the Mantaro peasants of Peru.

Table 11. Number of trees as influenced by mobility of head of household

Mobility of head	Number of households	Mean rank	Median number of trees
Immobile	43	91.9	2
Slightly mobile	144	154.2	14
Moderately mobile	109	237.9	63
Highly mobile	105	271.5	86

KW = 111.767, df = 3, $p<0.0001$.

The possible reason could be visualised in terms of the total income and employment status across mobility categories. Mobility was highly positively correlated with total household income ($r_s = 0.591$, $p<0.0001$). Households with higher total income were more mobile because they could afford travel expenditure. These households had higher income and therefore greater capacity to risk the incorporation of trees on farm. There was also a highly significant association of mobility with the occupation of the head of the household ($r_s = 0.431$, $p<0.0001$), farmers with an off-farm occupation being more mobile.

Importance of Growing Trees on-Farm for Future Generations of the Household

In the study area the well-being of future generations is traditionally the responsibility of the head of household. The household head seeks to gain or retain assets to pass on to the children. Growing trees might be such an activity because it increases the value of the on-farm assets to be inherited. Such notions are culturally based but may vary between households. Farmers were asked to state how important they consider tree growing to be for future generations. The median number of trees increased significantly with increase in the level of importance of responsibility of tree growing for household future generations (Table 12).

Table 12. Number of trees per household as influenced by stated importance of tree growing for future generations

Level of importance	Number of households	Mean rank	Median number of trees
Not important at all	160	115.0	10
Important	117	219.0	38
Very important	124	295.1	134

KW = 173.065, df = 2, p<0.0001.

Worship of Holy Trees

In many countries of the world, particular species of trees or simply individual trees with special shapes have distinctive religious or spiritual connotations. This can often influence tree cultivation practices (Carter 1995). The present study area is Hindu-dominated and many plants and trees – including Pipal (*Ficus religiosa*) and Daru (*Punica granatum*) – are holy trees for Hindus. Some farmers were observed to water Pipal trees (a form of worship) in the morning hours. Thus tree worship may influence on-farm tree growing.

Households were categorised into three categories on the basis of worship of trees, namely those households where nobody worshipped holy trees, those where at least one member performed holy tree worship occasionally such as on particular social ceremonies, and those where at least one member frequently performed tree worship. The median number of trees varied significantly across the three worship categories (Table 13).

Table 13. Number of trees as influenced by holy tree worship

Type of worship	Number of households	Mean rank	Median number of trees
No worship	192	127.13	10
Occasional	125	254.54	75
Usual	84	290.18	130

KW = 154.764, df = 1, p<0.0001.

Although old farmers are considered more traditionalist and therefore households headed by old farmers are expected to be tree worshippers, no association between age and holy tree worship was detected (χ^2 = 1.888, p<0.758). This was consistent with field observations where farmers of different age groups had a fair knowledge of holy tree worship. Holy tree worship is considered a cultural prerogative of the higher castes in the study area which is demonstrated by significant and positive association between caste and holy tree worship (r_s = 0.122, p<0.010).

CONCLUSIONS AND POLICY IMPLICATIONS

Mixed findings were obtained concerning the relationship between various socio-economic and physical factors and tree planting. Age of the household head, family type and land tenure do not appear to be determinants of tree growing. The mobility of the respondent affected the extent of farm level tree growing because more mobile farmers are exposed to new farming practices, contacts with the outside world (where the principle of 'seeing is believing' operates) and awareness of procedures for tree felling and timber transport and sale, and the demand-supply relations of tree products. The mobility of the farmers could be increased by the creation of off-farm employment opportunities, including government employment. Mobility of farmers is constrained by their low incomes, so ways need to be found to increase farm incomes in order to gain wider adoption. Older farmers have the potential to grow more trees due to their larger farms. The significant and negative association observed between the age of the head of the household and mobility implies that old farmers could be encouraged to grow trees by increasing their mobility which would expose them to the outside world (to demand-supply of tree products, rules and regulations and related relaxations on use of on-farm trees, and services available to take up on-farm tree growing) to induce imitational effect.

No relationship was found between family size and extent of agroforestry adoption. The reason could be that large households have a high consumption of tree products but not necessarily a scarcity of tree products. For instance, there was a non-significant association between family size and perceived scarcity of fuelwood for domestic use. Another possible reason may be that the greater demand for food production in large households may preclude the opportunity of tree growing, because trees compete for space with agricultural crops.

Heterogeneity of social structure leads to heterogeneity of interests and livelihoods. Since there was a social restriction in the free mixing of lower and upper castes in the study area, planners should recognise the caste system when forming extension strategies. Lower castes in general, and households with smaller farms, lower income, and lower food sufficiency within lower castes in particular, were laggards in extending the level of on-farm tree growing. The lower extent of tree growing in lower castes could therefore be ascribed to the resource constraints. This suggests that lower caste households may not be averse to extend the level of on-farm tree growing if they did not have constraints on availability of resources of land, food and income. Educational and job reservation for lower castes could be targeted to the poor within lower castes, to raise their off-farm incomes. More off-farm income earning opportunities could be created to provide secure income to lower caste households. The implication is that planning agencies should aim at

extending the benefits of various current programs (educational and job reservation, subsidised ration for lower castes) to target the poor within lower castes. This implies an opportunity for integration of various rural development programs with agroforestry programs rather than executing agroforestry programs in isolation.

The finding that the extent of tree cultivation is influenced by the importance of tree growing for future generations shows a need to inculcate such values in the society to increase on-farm tree growing. The worshipping of holy trees which is engrained in the Hindu social (caste) structure has a positive influence on on-farm tree growing and thus may have potential to influence adoption of agroforestry.

Potential extenders of on-farm tree growing are the households with concrete houses. Extension agencies can use house type as a visible indicator for reconnaissance work to identify potential tree-growers when extension agencies lack the time and funds to conduct detailed surveys.

Both the education of the head of the household and the family significantly influence tree growing. This implies a need for long-term planning to increase education level of the society to encourage on-farm tree growing.

ACKNOWLEDGMENTS

I thank the Association of Commonwealth Universities of the United Kingdom for providing a Commonwealth Fellowship to support this study, and also the University of Aberdeen for partial funding of fieldwork in India. I thank Professor C.P. Mitchell, University of Aberdeen, UK, for his guidance and help in conducting the study and analysing the data. The British Council also deserves special thanks for the administration of the Fellowship.

REFERENCES

Agarwal, B. (1986), 'Of social forestry and other tree-planting schemes', in B. Agarwal, *Cold Hearths and Barren Slopes: the Woodfuel Crisis in the Third World*, Zed Books, London, pp. 106-139.

Akbar, G., Baig, M.B. and Asif, M. (2000), 'Social aspects in launching successful agroforestry projects in developing countries', *Science Vision*, 5: 52-58.

Arnold, J.E.M. and Dewees, P.A. (1995), *Tree Management in Farmer Strategies: Responses to Agricultural Intensification*, Oxford University Press, Oxford.

Atul, Punam and Khosla, P.K. (1994), 'Himachal Himalayan agroecosystem status: a case study', *Biological Agriculture and Horticulture*, 10(4): 271-276.

Ayling, D.R. (1991), *Making Forestry Research Relevant to Third World Farmers*, Social Forestry Network Paper 12d, Overseas Development Institute, London.

Balokhra, J.M. (1999), *The Wonderland Himachal Pradesh – A Survey of the Geography, People, History, Administrative History, Art and Architecture, Culture and Economy*, H.G. Publications, New Delhi.

Carter, J. (1995), 'Tree cultivation by farmers in Dolakha district, Nepal,' in N.C. Saxena and V. Ballabh (eds), *Farm Forestry in South Asia*, Sage Publications, New Delhi, pp. 104-138.

Cernea, M.M. (1992), 'A sociological framework: policy, environment and the social actors for tree planting', in N.P. Sharma (ed.), *Managing the World's Forest: Looking for the Balance between Conservation and Development*, Hunt Publication Co., Iowa. pp. 301-336.

Cernea, M.M. (1994), 'Using knowledge from social science in development projects', *Project Appraisal*, 9: 83-93.

Chundamannil, M., Krishnankutty, C.N. and Rajan, A.R. (1993), *Socio-economic Study of Farm Forestry – A Survey of Four Villages in Kerala*, KFRI Research Report No. 90, Kerala Forest Research Institute, India.

DFID (1999), *Country Strategy Papers, India*, Department for International Development (United Kingdom), London.

Feder, G., Just, R.E. and Zilberman, D. (1985), 'Adoption of agricultural innovations in developing countries: a survey', *Economic Development and Cultural Change*, 33: 255-298.

Fortmann, L. (1988), 'Great planting disasters: pitfalls in technical assistance in forestry', *Agriculture and Human Values*, 5: 49-60.

FSI (Forest Survey of India), (1999), *State of Forest Report*, Ministry of Environment and Forests, Dehra Dun, India.

Garforth, C.J., Malla, Y.B., Neupane, R.P. and Pandit, B.H. (1999), 'Socioeconomic factors and agroforestry improvement in the hills of Nepal', *Mountain Research and Development*, 19(3): 273-278.

Gilmour, D.A. and Nurse, M.C. (1995), 'Farmer initiatives in increasing tree cover in central Nepal', in N.C. Saxena and V. Ballabh (eds), *Farm Forestry in South Asia*, Sage Publications, New Delhi/ Thousand Oaks, London, pp. 87-103.

Glendinning, A., Mahapatra, A. and Mitchell, C.P. (2001), 'Modes of communication and effectiveness of agroforestry extension in Eastern India', *Human Ecology*, 29(3): 283-305.

GOHP (1997), *Brief Facts. Himachal Pradesh*, Department of Statistics and Economics, Government of Himachal Pradesh, Shimla.

GOHP (2000), *Himachal in Figures*, Department of Economics and Statistics, Government of Himachal Pradesh, Shimla.

GOHP (2001), *Economic Survey of Himachal Pradesh*, Department of Economics and Statistics, Government of Himachal Pradesh, Shimla.

Hoskins, M.W. (1987), 'Agroforestry and the social milieu', in H.A. Steppler and P.K.R. Nair (eds), *Agroforestry: A Decade of Development*, ICRAF, Nairobi, pp. 191-203.

Jacob, V.J. and Alles, W.S. (1989), 'The Kandyab gardens of Sri Lanka', in P.K.R. Nair (ed.), *Agroforestry in the Tropics*, Kluwer Academic Publishers in cooperation with ICRAF, Dordrecht, pp. 181-195.

Jha, L.K. (1996), *Forestry for Rural Development*, S.B. Nangia for APH Publishing Corporation, New Delhi.

Kachru, S.R. (1997), Diagnostic Survey and Productivity Appraisal of Agroforestry Systems in Subtemperate and Sub-humid Region of Himachal Pradesh, MSc thesis (unpublished), Dr. Y.S. Parmar University of Horticulture and Forestry, Solan, India.

Lionberger, H.F. (1960), *Adoption of New Ideas and Practices*, Iowa State University Press, Ames.

MacDonald, A.L. (1976), *Agriculture Technology in Developing Countries*, Rotterdam University Press, Rotterdam.

Mahapatra, A.K. (1997), Factors Influencing Adoption of Farm Level Tree Planting in Social Forestry in Orissa, India, PhD thesis (unpublished), University of Aberdeen, Scotland.

Mahapatra, A.K. and Mitchell, C.P. (2001), 'Classify tree planters and non-planters in subsistence farming system using a discriminant analytical approach', *Agroforestry Systems*, 52(1): 41-52.

Malla, Y.B. (2000), 'Farmer's tree management strategies in a changing rural economy and factors influencing decisions on tree growing in Nepal', *International Tree Crop Journal*, 10: 247-266.

Mercer, D.A. and Hyde, W.F. (1991), 'The economics of agroforestry', in W.R. Burch and J.K. Parker (eds), *Social Science Applications in Asian Agroforestry*, Winrock International, USA, Oxford and IBH Publishing Company, New Delhi, pp. 111-143.

Mercer, D.E. and Miller, R.P. (1998), 'Socio-economic research in agroforestry: progress, prospects, and priorities', *Agroforestry Systems*, 38(1-3): 177-193.

Nair, P.K.R. (1998), 'Directions in tropical agroforestry research: past, present and future', *Agroforestry Systems*, 38(1-3): 223-245.

Nair, P.K.R. and Dagar, J.C. (1991), 'An approach to developing methodologies for evaluating agroforestry systems in India', *Agroforestry Systems*, 16(1): 55-81.

Negi, Y.S. (1993), The Conditions for Agroforestry on Farms in the Western Himalayas of India, PhD thesis (unpublished), University of California, San Diego.

Neupane, R.P., Sharma, K.R. and Thapa, G.B. (2002), 'Adoption of agroforestry in the hills of Nepal: a logistic regression analysis', *Agricultural Systems*, 72(3): 177-196.

Raintree, J.B. (1986), 'Designing agroforestry for rural development: ICRAF's diagnosis and design approach', in P.K. Khosla, S. Puri and D.K. Khurana (eds), *Agroforestry Systems - A New Challenge*, ISTS, Solan, pp. 131-150.

Rogers, E.M. (1995), *Diffusion of Innovations* (4th edn), The Free Press, New York.

Rogers, E.M. and Svenning, L. (1969), *Modernisation Amongst Peasants, The Impact of Communication*, Holt, Rinehart and Winston, New York and London.

Royer, J.P. (1987), 'Determinants of reforestation behaviour among southern landowners', *Forest Science*, 33(3): 654-667.

Saxena, N.C. (1995), 'Trees on farm lands in Uttar Pradesh: socio-economic characteristics of tree planters', in N.C. Saxena and V. Ballabh (eds), *Farm Forestry in South Asia*, Sage Publications, New Delhi, pp. 219-244.

Saxena, N.C. and Srivastva, R. (1995), 'Tree growing as an option for supervision-constrained farmers in North-west India', in N.C. Saxena and V. Ballabh (eds), *Farm Forestry in South Asia*, Sage Publications, New Delhi, pp. 261-273.

Scherr, S.J. (1995), 'Meeting household needs: farmer tree growing strategies in western Kenya', in J.E.M. Arnold and D.A. Dewees (eds), *Tree Management in Farmer Strategies: Responses to Agricultural Intensification*, Oxford University Press, Oxford, pp. 141-173.

Sheikh, A.D., Rehman, T. and Yates, C.M. (2003), 'Logit models for identifying the factors that influence the uptake of 'no tillage' technologies by farmers in the rice-wheat farming systems of Pakistan's Punjab', *Agricultural Systems*, 75(1): 79-95.

Sharma, S., Rikhari, H.C. and Palni, L.M.S. (1999), 'Conservation of natural resources through religion: A case from Central Himalaya', *Society and Nature*, 12: 599-622.

Singh, B. (1992), *Social Forestry for Rural Development. A Socio-economic Perspective,* Anmol Publications, New Delhi.

Singh, D.V. and Sikka, B.K. (1993), *Impact Evaluation Study, National Social Forestry Project Himachal Pradesh,* Agro-Economic Research Centre, Himachal Pradesh University, Shimla.

Singh, R.V. (1986), *People's Participation in Social Forestry Programmes in Himachal Pradesh*, Forest Research Institute and Colleges, Dehra Dun.

Singhal, R.M. and Kumar, V. (1997), 'An analysis of socio-economic implications influencing people's participation in silvi-pastoral system of a micro watershed in Garhwal Himalaya', *Indian Forester*, 123(2): 136-142.

Sood, K.K. (2003), Factors affecting Tree Growing in Traditional Agroforestry Systems in Western Himalaya, India, PhD thesis (unpublished), University of Aberdeen, Scotland.

Sood, K.K. and Mitchell, C.P. (2004), 'Do socio-psychological factors matter in agroforestry planning? Lessons from small holder traditional agroforestry systems', *Small-scale Forest Economics, Management and Policy,* 3(2): 239-255.

Sood, K.K. and Sood, S. (2000), 'Social and agroforestry interventions for socio-economic and ecofriendly development around cement plant and limestone mining area in Western Himalaya', *Journal of Environment and Pollution*, 7: 17-22.

Sood, K.K., Soni, J.C. and Singh, B. (2000), 'Forest resource use of the tribals in Papumpare district of Arunachal Pradesh, India', *NERIWALAM,* Proceedings of National Seminar on Resource Management for Self Reliant Agriculture Economy of NE Region, Tezpur, September 2000, Tezpur, pp. 19/4-22/4.

Verma, K.S. and Mishra, V.K. (2000), 'Agroforestry systems', in L.R. Sharma (ed.), *Natural Resources and Development in Himalaya,* Malhotra Publishing House, New Delhi.

Verma, L.R. and Partap, T. (1992), 'The experiences of an area based development strategy in Himachal Pradesh, India', in N.S. Jodha, M. Banskota and T. Partap (eds), *Sustainable Mountain Agriculture*, Oxford and IBH Publishing Company, New Delhi.

Walters, B.B. (1997), 'Human ecological questions for tropical restoration: experiences from planting native upland trees and mangroves in the Philippines', *Forest Ecology and Management*, 99(1-2): 275-290.

Wiersum, K.F. (1984), 'Significance of social organisation and cultural attitudes for agroforestry development', in K.F. Wiersum (ed.), *Viewpoints on Agroforestry*, Department of Forestry, Wageningen Agriculture University, Wageningen, pp. 189-200.